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Reconciling large-scale use of common materials with the unique nature of each classroom grouping is the central problem of the curriculum developer. Certain generally applicable educational principles can aid in coping with these problems when coupled with empirical testing of all materials with children and/or teachers. But, the payoff of curriculum development is what happens to teachers and children in the classroom. Curriculum evaluation is concerned with describing this result. Evaluation studies have to take place at a time when the materials have stabilized; yet the studies have to last long enough to examine longitudinal implications. The tradition of educational evaluation has, unfortunately, concentrated on the achievement of the individual child, and no attention has been paid to the objectives for which the teachers actually use curriculum materials, the classroom processes through which teachers try to attain these objectives, etc. (DE)

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SOME THOUGHTS ON CURRICULUM DEVELOPMENT

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Some Thoughts on Curriculum Development

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My remarks will be quite frank, somewhat personal, and hopefully provocative. They do not reflect the official position of the Science Curriculum Improvement Study, where most of my experience has occurred.

As a relatively recent newcomer to the field of education, I am not committed to any particular theory in the social sciences. In fact, I believe that there is no satisfactory theory of instruction or of learning which leads unambiguously to a teaching-learning experience once an educational objective has been specified. Instead, there are fragments of theories dealing with parts, and often quite small parts, of the whole picture. My approach to questions or decisions in curriculum construction has been to rely on the judgment (or "hunches") of my colleagues and myself, and to subject this judgment to empirical tests in elementary school classrooms or other appropriate teaching situations. After this test, it has almost always been possible to "explain" the result on the basis of one theory and to use it to show the inadequacy of other theories. Unfortunately, we were usually not able to identify the appropriate theory and its specific form of application in advance. Yet, to be a genuinely useful tool, a theory must be employed in advance, and should reduce the need for experimental

testing of teaching hypotheses. (See Karplus and Thier, pp. 14-18 for a summary of procedures used by SCIS.)

What are some decisions that have to be made, or questions that have to be answered? Some deal with concepts: can children learn to use the interaction concept, or the state of a system concept? Some deal with sequence: what difference does it make if the systems concept is taught before or after the interaction concept? Some deal with children's dexterity: can children operate the alligator clips or Fahnstock clips used to make electrical connections? Some deal with equipment utilization: can two children work while sharing one relief map, or should each one work with his own map? Some deal with pacing: should an idea be repeated in several very similar versions, or should more contrasting examples be used in close succession?

I am sure that these questions should be answered differently for different teachers and different groups of children. This fact points up the uniqueness of each school classroom, and the strong dependence of education on the personalities of teacher and children. In utopia each class group would create it own unique curriculum, using the resources of its members, its community, and its natural environment. (According to many of my informed friends, the British infant schools are moving in this direction.) Nevertheless, it is the curriculum developer's responsiblity to identify common needs of all classes and to create curriculum materials that can add to the resources available for each class. A large scale demand for such materials then makes it feasible to produce and market them economically.

In a sense, I have now put myself into the position of defending the existence of the curriculum developer. My basic assumption is that there is value in the specialization of labor here as in other endeavors. By having a small number of individuals concentrate their efforts on the solution of common problems, the satisfaction of common needs, and the realization of common opportunities, the large number of teachers will be able to conduct more effective teaching programs than they would without this assistance.

We can now return to the questions I raised before. In spite of the uniqueness of each classroom, I believe it is important that broadly applicable answers be formulated and made available to teachers. These answers should not be interpreted as unfailing prescriptions for "success," but as a first approximation on which each individual class can improve according to its particular circumstances. I have spent much time on this point because I consider the problem of reconciling the large scale-use of common materials with the unique nature of each class group to be central to the improvement of education. (The problem is analogous to the one faced by the teacher with a program for the whole class and thirty unique children.) I am strongly opposed to the educational philosophy according to which a curriculum developer should establish objectives to be achieved by all children if the teacher uses the materials "correctly." Instead, a range of attainable objectives should be indicated, with the teacher (and children?) imposing his priorities and accordingly choosing or emphasizing activities that can be

carried out with the materials. Such an approach provides for variations in the sharing of curriculum responsibility. The new teacher can minimize his contribution by following the suggested outline very closely, while the experienced teacher may adapt the program very extensively to his class's needs and special interests. It is important, however, that all teachers feel some responsibility for decision making and do not teach merely "because the book said so."

Now I shall identify several educational principles which I have found quite widely applicable, but they don't come close to forming a comprehensive theory.

1. The program must provide for educational input to the children. This can come from structured experiments, the teacher, reading materials, or other sources. The input is organized into a coherent conceptual structure.
2. The program must provide for spontaneous or autonomous activities by the children which are built on the intrinsic interest of the curriculum materials.
3. Beyond a certain point, educational input is not intrinsically interesting and should be supported by social influences. One of these is the educational or social value of the study, a second is identification with the teacher as model, a third is compliance with an authoritarian teacher.
4. The pattern of exploration--invention--discovery (see Karplus and Thier, pp. 40ff) provides for alternation of input activities (invention) and more or less spontaneous investigation (exploration, discovery). The autonomous activities, furthermore,

provide feedback to aid the teacher's planning of the program's continuation.

5. Developmental learning theory is more reliable in the cognitive area, behavioristic learning theory is more appropriate for attitude formation. One implication of this principle is that concept formation should be pursued at low pressure over long periods of time; that is why individual activities have to fit an overall conceptual structure, but repetition and drill should be minimized. A second implication is that positive attitudes (interest, imaginative proposals, evaluation of ideas) should be encouraged by prompt reinforcement without regard to their level of sophistication or accuracy.

6. Teachers should allow substantial time for pupil talk during a discussion and should not control its flow by channeling all remarks through themselves.

These principles, coupled with the empirical approach of testing all materials with children and/or teachers, has enabled my colleagues and me to cope with our curriculum development problems. Any success we have had in this activity is due to the competence and creative imaginations of the members of the innovative team whose special qualifications complement one another effectively.

There are many organizational details to be provided for in a curriculum development project, and all require attention, care, and effort. Support money must be secured, laboratory schools must be available, teacher education must be provided, equipment

must be designed and manufactured, books must be written, illustrated, and printed, information must be furnished to the public, and all the staff members must find satisfaction in their work. For a curriculum project to have a significant impact on the schools, its products must become commercially available. That means identifying and licensing a competent publisher and manufacturer, maintaining quality control checks over their production, supervising their costs and production schedules, acting as intermediary to provide customer service in case of delivery problems, and so on. Finally, the new materials must find acceptance in the schools. Even though these matters are not usually considered academic in nature, they are a vital part of the process of affecting education practice and as such as inextricably linked with the curriculum development. It goes without saying that a full time, carefully selected staff is a sine qua non.

The pay-off of curriculum development is what happens to teachers and children in the classroom. Curriculum evaluation is concerned with describing the result. I should point out that such an investigation is different from the gathering of feedback that is an essential part of the development process described above. In other words, the classroom testing of trial materials requires the collection of information (feedback) with the help of which the development process can be maintained, adjusted, or reoriented, as necessary. All projects have done this with the help of feedback conferences, teacher questionnaires, classroom observations, and tests of individual children. In curriculum evaluation, by contrast,

I refer to the study of what happens in schools which use the new materials. The enclosed booklet "What is Curriculum Evaluation" illustrates the range of activities in which the Science Curriculum Improvement Study has engaged.

Curriculum evaluation is an extended activity of broad scope, because the adoption of a new curriculum such as "Science - A Process Approach," the New Math, or SCIS, has extensive ramifications. First of all, the study has to take place at a time when the materials are stable, that is, not subject to frequent revision and change. Second, it has to last long enough so that some of the longitudinal implications can be examined. Third, it has to deal with single children, classroom groups of children and teachers (including the effects on non-science teaching procedures), entire schools with their teachers and administrators, school district officials who are involved in the teacher education and procurement aspects, and the community which provides financial support and presumably expects certain educational benefits. Unfortunately, the tradition of educational evaluation has concentrated heavily on the achievement of the individual child, and almost no attention has been paid to objectives for which the teachers actually use curriculum materials, the classroom processes through which teachers try to attain these objectives, and so on. No new curriculum has been evaluated from this point of view to my knowledge. The most that has been done is in NLSMA (by the School Mathematics Study Group) and by Millie Almy (Teachers College) in a recent two-year study of science and math curricula in kindergarten and first grade.

Because the new elementary science materials are only now reaching the public in their final forms, the evaluation I have described is yet to come. Hopefully, someone will undertake such a project, and we should certainly be delighted to cooperate fully. Is this really part of curriculum development or is this a separate problem?

The time required for implementation of the new science programs will, I hope, result in a moratorium on additional massive projects until the present generation has been digested. I see this time being used for research on children's learning under the conditions of the new programs. It is especially important to bring our knowledge of children's intellectual development in the upper elementary grades to the same level as our knowledge of children in the primary grades. In Piaget's terms, the former covers the transition to formal thought, the latter the transition to concrete operations. The relation of science to mathematics is important, as is the impact of the new linguistic programs on children's ability to act when given written instructions.

Beyond this, I expect a more integrated attack on pre-college science, in contrast to the past decade's separate approach to elementary school, junior high school, and high school. And yet, the undertaking is so massive that I question whether satisfactory leadership can be provided for such a project. I also expect a trend toward inter-disciplinary science at the high school level, with some projects (Portland State) already active. Finally, progress has to be made toward more self-direction by the students. Actually,

I am so deeply involved in my present work that I have difficulty speculating further about the future.

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